

I claim:

1. A tactile feedback apparatus for a cursor control device comprising:

a cursor control mechanism;

a piezo-electric material mounted on a semi-rigid substrate;

5 the substrate coupled to the cursor control mechanism; and

a control circuit electrically interconnected to the piezo-electric material for providing a signal to cause the piezo-electric material to vibrate.

2. The tactile feedback apparatus device of claim 1, further comprising:

10 the cursor control device providing a z-axis output signal;

the control circuit sensing the z-axis output signal and providing a control signal to cause the piezo-electric material to vibrate in response to the z-axis output signal.

3. The tactile feedback apparatus of claim 1 and wherein:

15 the semi-rigid material is a thin layer of metal.

4. The tactile feedback apparatus of claim 1 and wherein:

the semi-rigid material is an alumina material.

20 5. The tactile feedback apparatus of claim 1 and wherein:

the semi-rigid material comprises an additional piezo-electric wafer.

6. The tactile feedback apparatus of claim 1 and wherein:
the semi-rigid material comprises a ceramic material.

7. The tactile feedback apparatus of claim 1 and further comprising:

- 5 an indicating circuit for providing an indicating signal when the cursor is placed over a predefined position on a display; and
the control circuit providing the control signal to cause the piezo-electric material to vibrate in response to the indicating signal.

10 8. The tactile feedback apparatus of claim 4 and wherein
the indicating circuit for providing an indicating signal is active when the cursor is placed over an active area on the display.

15 9. The tactile feedback apparatus of claim 1 and wherein the piezo-electric material
comprises a plurality of layers of piezo-electric material.

10. A computer input system comprising:

a computer;

20 a cursor control device electrically interconnected to the computer;

software for determining a cursor position based upon user actuation of the cursor control device;

the cursor control device further comprising:

an x-, y-, and z-axis sensor system;

a piezo-electric material mounted to a semi-rigid material and mechanically coupled to the cursor control device;

an electrical interconnection between the computer and the piezo-electric material, the

5 piezo-electric material being formed to vibrate upon activation by a predefined electrical signal;

the piezo-electric material providing tactile feedback to the user when activated by the predefined electrical signal.

10 11. The computer input system of claim 6 and further comprising:

the predefined electrical signal is an ac signal.

12. The computer input system of claim 7 and wherein

the ac signal is at least 20 volts peak to peak with a frequency of at least 300 Hz.

15 13. The computer of claim 6 and wherein:

The software determines a condition requiring tactile feedback and provides the electrical signal to the piezo-electric material in the cursor control device.

20 14. The computer of claim 6 and wherein:

The cursor control device includes an electric circuit for generating the predetermined signal to activate the piezo-electric material.

15. The computer input system of claim 6 and wherein the cursor control device is a pointing stick.

5 16. The computer input system of claim 6 and wherein the cursor control device is a mouse.

17. A pointing stick for use as a cursor control device comprising:

a shaft accessible to the user for providing a physical input for cursor control;

10 at least one sensor mounted on the shaft for sensing the physical input applied by the user;

a piezo-electric assembly including piezo-electric material mounted to a semi-rigid material;

an electrical interconnection to the piezo-electric material for providing a driving signal to the piezo-electric material;

15 the piezo-electric assembly being mechanically coupled to the pointing stick to couple vibrations from the piezo-electric assembly to the pointing stick.

18. A tactile feedback for a cursor control device comprising:
a user-actuated linkage for providing a desired cursor movement;
a piezo-electric assembly operable as a source of vibrations; and
a control device for sensing a predefined condition and providing an electrical signal to
5 activate the piezo-electric assembly; and wherein the piezo-electric assembly is
mechanically coupled to the user-actuated linkage to deliver the vibrations to the user.

19. A method for providing a tactile feedback comprising the following steps:
providing a cursor control device;
10 providing a piezo-electric assembly that vibrates upon electrical activation;
mounting the material to the cursor control device to provide a mechanical transfer of
vibrations from the material to the cursor control device;
sensing a predefined condition for which tactile feedback is desired; and
15 activating the piezo-electric assembly to provide mechanical vibrations to the cursor
control device.